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Research Note

Hemogregarines (Apicomplexa) and *Falcaustra chelydrae* (Nematoda) in an Alligator Snapping Turtle, *Macroclemys temminckii* (Reptilia: Testudines), from Arkansas

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ABSTRACT: Two alligator snapping turtles, *Macroclemys temminckii* (Harlan, 1935), were collected from 2 counties in Arkansas and examined for gastrointestinal and hemoparasites. One of the turtles was found to be harboring 3 different hemogregarine forms in erythrocytes, and kathlaniid nematodes, *Falcaustra chelydrae* Harwood, 1932, were recovered from the rectum. This represents the first definitive report with quantitative information and photomicrographs of hemogregarines in *M. temminckii*. In addition, we document *F. chelydrae* in *M. temminckii* for a second time with Arkansas representing a new geographic distribution record for the parasite.

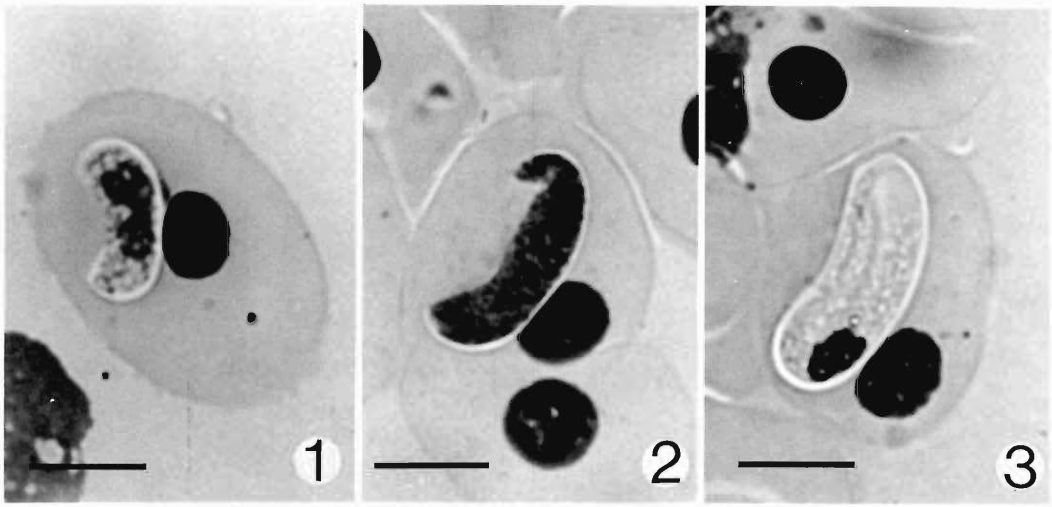
KEY WORDS: Apicomplexa, *Falcaustra chelydrae*, Nematoda, gamonts, hemogregarines, *Macroclemys temminckii*, alligator snapping turtle, Testudines, Chelydridae, Arkansas.

The alligator snapping turtle, *Macroclemys temminckii* (Harlan, 1835), is the largest North American freshwater turtle; males may attain weights of more than 140 kg (Lovich, 1993). This turtle is restricted to river systems of the United States that drain into the Gulf of Mexico and is distributed widely from Oklahoma, Kansas, Illinois, and Indiana south to Texas and east to Florida (Conant and Collins, 1991). The species is economically important, has been exploited for years as a food resource and may be disappearing from much of its range (Pritchard, 1989).

Lovich (1993) summarized biological information on *M. temminckii*; however, little is known about its helminth fauna (Ward and Hopkins, 1931; Mackin, 1936; Cahn, 1937; Ernst and Ernst, 1977), and even less information is available on the protozoan parasites of this turtle (Ernst and Ernst, 1979; Upton et al., 1992). The purpose of this note is to provide quantitative information and photomicrographs of hemogregarines from this host and to report a new locality record for a nematode parasite of this turtle.

During early September 1993 and mid-April 1994, 2 adult male *M. temminckii* (carapace length = 51 and 53 cm) were collected alive, 1 from an Oxbow Lake off the Ouachita River in the vicinity of Camden (33°35′N, 92°50′W), Ouachita County, and 1 from Village Creek in the vicinity of Swifton (35°49′N, 91°07′W), Jackson County, Arkansas. The turtles were transported to the laboratory and overdosed with sodium pentobarbital (Nembutal®, Abbott Laboratories, North Chicago, Illinois) by intracardial injection for examination of gastrointestinal and hemoparasites. Blood samples were obtained from heavily anesthetized turtles by tail-clipping, and thin films were methanol-fixed and stained with Giemsa or Wright's. Immediately following euthanasia, the gastrointestinal tract from the esophagus to anus was removed and examined for helminths. Rectal contents and feces were collected, placed in 2.5% (w/v) aqueous potassium dichromate, and processed for coccidia using previously described methods (Upton et al., 1992). Nematodes were preserved in 70% ethanol and examined using a glycerol wet mount. Measurements were made on a total of 55 intraerythrocytic parasites (15–20/form) using a calibrated ocular micrometer under a ×100 oil immersion lens and are reported in micrometers as means ± SD followed by the ranges in parentheses. Mean length and width measurements were tested for statistical significance ($P \leq 0.05$) using 1-way ANOVA followed by a posteriori Student-Newman-Keuls (SNK) procedure for multiple comparisons (SAS Institute, 1988).

Host vouchers are deposited in the Arkansas State University Museum of Zoology as ASUMZ 19261 and 19544. Voucher specimens of parasites are deposited in the U.S. National Parasite



Figures 1–3. Three different hemogregarine forms in erythrocytes of *Macroclemys temminckii* from Arkansas. 1. Small form resembling a macrogamont. 2. Medium form resembling a microgamont. 3. Large form resembling an immature erythrocytic gamont. Scale bar 10.0 μm.

Collection (USNM), Beltsville, Maryland 20705, as follows: hemogregarines (USNM 83473), *Falcaustra chelydrae* (USNM 83475).

One turtle (Ouachita County specimen, ASUMZ 19261) was found to be harboring parasites, including 3 different hemogregarine forms and a kathlaniid nematode, *Falcaustra chelydrae* Harwood, 1932. Although coccidia have been reported previously in *M. temminckii* from Arkansas (Upton et al., 1992), both turtles examined in this study were negative.

In blood smears, 3 distinct morphological and statistically different types of hemogregarine forms were observed (Figs. 1–3; Table 1). One form was small, resembling a macrogamont, and had a lightly staining cytoplasm, often curved in shape with a centrally located nucleus (Fig. 1). An intermediate form resembling a microgamont, the least commonly observed, had a basophilic cytoplasm, centrally located nucleus, and a curved tail (Fig. 2). Hemogregarines from turtles are known to exhibit sexual dimorphism in the gamont stage (Siddall and Desser, 1992). Further, Paterson and Desser (1976) noted that gamonts with a slightly recurved tail are microgamonts that divide into microgametes in the intestines of leeches. In size, both micro and macrogamonts were similar to those of *Haemogregarina balli* Paterson and Desser, 1976, described from the common snapping turtle, *Chelydra serpentina* (Linnaeus, 1758), in Ontario, Canada (Paterson and Desser, 1976). The most common form was large and stout and resembled an immature (nondividing) erythrocytic meront

Table 1. Measurements of 3 hemogregarine forms found in erythrocytes of *Macroclemys temminckii*.

Morphological type	Length (μm)* $\bar{x}$ ± SD (range)	Width (μm)† $\bar{x}$ ± SD (range)
Small form (N = 20)	12.3 ± 1.2 (10.4–14.4)	4.6 ± 0.6 (4.0–5.4)
Medium form (N = 15)	19.0 ± 1.2 (16.0–20.8)	4.8 ± 0.5 (4.0–5.6)
Large form (N = 20)	32.6 ± 2.2 (28.0–36.8)	4.0 ± 0.6 (3.2–4.8)

* The means of all lengths were significantly different (ANOVA, $F = 774.73$, $P < 0.00001$). All critical values for within mean length comparisons were significantly different at $P < 0.05$ by SNK procedure ($q = 16.83$–54.83).

† The means of all widths were significantly different (ANOVA, $F = 11.87$, $P < 0.0005$). Critical values for within mean width comparisons were significantly different at $P < 0.05$ by SNK procedure for small to large ($q = 4.98$) and medium to large forms ($q = 6.53$) but not significantly different for small to medium forms ($q = 1.92$).

with an eccentric nucleus and a curved, tapered tail that was often folded on itself (Fig. 3). This latter form was similar to immature meronts described in detail by Siddall and Desser (1992). Although we have refrained from designating a genus for these hemogregarines at this time, the parasite most probably represents a species of *Haemogregarina* (sensu stricto) or a species of *Hepatozoon*. Indeed, the presence of erythrocytic meronts suggests the former, as the latter does not undergo erythrocytic merogony. Telford (1984) cautioned that hemogregarines cannot be consistently distinguished based solely on their erythrocytic stages.

Hemogregarines have been extensively studied and reported from *C. serpentina* from various states and southern Ontario, Canada (e.g., Desser, 1973; Ernst and Ernst, 1979; Strohlein and Christensen, 1984; Siddall and Desser, 1991, 1992). Our report for the first time provides documentation with quantitative information and photomicrographs of hemogregarines in the related chelydrid, *M. temminckii*. In a report on peripheral blood components, Powell and Knesel (1993) reported intraerythrocytic parasites in *M. temminckii* from Louisiana without further comment. In addition, McAllister and King (1980) found 4 different hemogregarine forms in red-eared sliders, *Trachemys scripta elegans* (Wied, 1838), from Arkansas. These forms tended to be smaller and were morphologically different, and photomicrographs of the hemogregarines did not resemble those from *M. temminckii*.

One hundred fifty-seven *Falcaustra chelydrae* were recovered from the rectum of *M. temminckii*. These nematodes fit descriptions of the parasite provided by Harwood (1932) and Mackin (1936). The species was originally described from *C. serpentina* in Texas (Harwood, 1932) and, although reported from *M. temminckii* once previously, the locality was unspecified (Mackin, 1936). However, other turtles reported by Mackin (1936) to be infected with *Falcaustra* spp. originated from areas within the range of *M. temminckii* in southeastern Oklahoma and Illinois. Therefore, we believe our survey to be the first definitive report of *F. chelydrae* from Arkansas. *Falcaustra chelydrae* infects numerous North American freshwater turtles from various localities in the United States and Ontario, Canada (see Baker, 1987), including the adjacent states of Oklahoma (Mackin, 1936; Williams, 1953; McKnight, 1958) and Tennessee (Reiber, 1941; MacDonald and Litchford, 1974). A related species, *Falcaustra affinis* (Leidy, 1856) Harwood, 1932 (syn. *F. concinnae* Mackin, 1936), was reported by Rosen and Marquardt (1978) from *T. scripta elegans* in Arkansas.

In summary, we have provided new information on 2 endoparasites of *M. temminckii*. However, since there still appears to be a paucity of parasite data on alligator snapping turtles, we suggest that future ecological and natural history studies incorporate survey information from *M. temminckii*, in order to develop a more complete understanding of its host–parasite relationships.

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